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memorandum

Los Alamos Neutron Science Center, LANSCE-1
Accelerator Physics and Engineering Group

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SUBJECT: SNS – COASTING BEAM SIMULATION RESULTS

As part of the initial SNS linac commissioning and later, during routine accelerator start-ups, it will be necessary to allow unaccelerated beam to coast through the linac. Simulations have been performed to predict at what energy the beam can be coasted through the remainder of the linac. The simulations were performed as if the linac were being turned on in stages. The energies and locations where the output beam from each stage was lost have been tabulated. A staged turn-on process will most likely be required during commissioning and operations. In order to control structure activation due to this beam loss, it will be necessary to implement a combination of intermediate beam stops and/or operating conditions (peak current, repetition rate, and pulse length) that will insure hands-on maintenance conditions. The simulations results and some recommendations are presented below.

A 10,000 maroparticle RFQ distribution was transported through the SNS linac using the PARMILA code. Sections of the linac were turned off in stages, beginning at the high-energy end until some beam loss was observed. The tanks of the DTL were also turned off to for this study. The simulation results are summarized in Table 1 below.

In a previous study [1], it was determined that an intermediate beam stop will be required to commission Tank 1 of the DTL. As can be seen from the results in Table 1, additional intermediate beam stops will be required after DTL Tanks 4 and 6 to commission DTL Tanks 2 and 3-4, respectively. Of course, these beam stops are only required if beam intensities high enough to damage the structures are used during turn-on/tune-up.

As can also be seen in the table, the nominal energy CCL output beam will coast through the entire SC linac. Additionally, it can be seen that all beam loss associated with setting the phases and amplitudes of the CCL RF modules will occur in the SC linac. Therefore, the end of the CCL is the ideal location for an intermediate beam stop. This beam stop will prevent beam spill in the SC linac during turn-on and tune-up of the linac. Excessive beam spill in the SC linac should be minimized to prevent quenching of the cavities. An intermediate beam stop placed at this location could also serve as a radiation safety system device and therefore, would allow tuning the DTL and CCL while other downstream activities take place. This would be similar to what is done at LANSCE. Figure 1 shows the locations of the required intermediate beamstops.

[1] R. Garnett, "SNS DTL Tank 1 Transmission With RF Off," Los Alamos National Laboratory Memorandum, LANSCE-1:00-061, June 27, 2000.

Table 1 – SNS linac simulation results for coasting beam.

Operating Conditions	**Beam Energy**	**Beam Loss Location**	**Fraction Beam Lost**
DTL Tanks 2-6 Off	7.52 MeV	Cells 32-48 DTL Tank2, Cells 1-6 DTL Tank 3	100 %
DTL Tanks 3-6 Off	22.84 MeV	Cells 1-20 DTL Tank 5	100 %
DTL Tanks 4-6 +CCL + SC Linac Off	39.79 MeV	Cavities 1-11 CCL	100 %
DTL Tanks 5-6 +CCL + SC Linac Off	56.58 MeV	Cavity 5 CCL, Cavities 5-17 SRF II	100 %
DTL Tank 6 +CCL + SC Linac Off	72.5 MeV	Cavities 5-20 SRF I	100 %
CCL Modules 1-4 +SC Linac Off	86.83 MeV	Cavity 6 of SRF I	99.3 %
CCL Modules 2-4 + SC Linac Off	107.16 MeV	Cavities 9-19 SRF I, 4-13 SRF II	85.4 %
CCL Modules 3-4 + SC Linac Off	131.14 MeV	Cavities 12-13 of SRF II	0.1 %
CCL Module 4 + SC Linac Off	157.21 MeV	Cavities 12 of SRF II	0.01 %
SC Linac, All Modules Off	185.68 MeV	1 GeV Linac Beam Stop	0 %

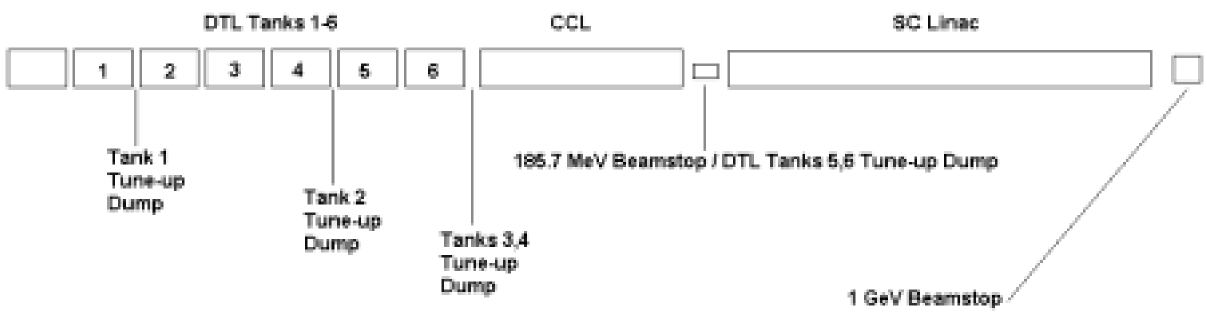

Figure 1 – Locations of intermediate tune-up beamstops required to avoid beam spill.

Typical turn-on/tune-up beam parameters used at LANSCE are 1 mA peak beam current, 10 Hz repetition rate, and 150 μsec pulse length. For the LANSCE 211 MeV beam stop, this is a maximum beam power-on-target of less than 320 watts. Additionally, they have been able to routinely spill this beam along the machine during turn-on while maintaining hands-on maintenance of the machine. If SNS can achieve similar tune-up parameters, they should also be able to maintain hand-on maintenance of their machine. There are trade-offs between spilling low-power beams and having many intermediate beam stops that should be studied.

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